# EFFECT OF WEATHERING UPON COMPOSITION OF HARDWOOD LEAVES

By HERBERT A. LUNT

*Connecticut Agricultural Experiment Station*

IN CONNECTION with an experiment pertaining to the amount and composition of the annual litter deposit in hardwood forests, it was found desirable to know what nutrient materials are removed from the leaves during their first month or two on the ground. Although other investigators have made a great many analyses of leaves taken from the tree at different stages of growth and, in the case of conifers, on one, two and three year old needles, no work has been reported to the writer's knowledge dealing with the natural losses in mineral constituents and nitrogen occurring immediately after leaf fall.

The nearest approach to a study of this kind was cited by Ebermayer (1) in which he stated that Schröder had leached freshly fallen beech leaves with distilled water, and obtained losses as follows:

| | |
|---|---|
| $Fe_2O_3$ (Ferric oxide) | 1.5 per cent |
| CaO (Calcium oxide) | 4.5 per cent |
| MgO (Magnesium oxide) | 19.6 per cent |
| $P_2O_5$ (Phosphorus pentoxide) | 19.7 per cent |
| $K_2O$ (Potassium oxide) | 52.6 per cent |
| $SO_3$ (Sulfur trioxide) | 55.3 per cent |

Ramann (3) states that most of the ash constituents of forest litter are in a readily soluble form but he gives no detailed data.

Therefore, in an attempt to throw some light upon the question, preliminary studies were made by the writer during the fall of 1932.

## Procedure

Certain trees were kept under observation and when leaf fall was well started the writer picked yellowed or browned leaves directly from the tree and some from the ground, in the latter case only those leaves which had dropped not more than a day or two previously. The leaves were put into two bags, equal distribution being obtained by putting alternate handfuls in each bag.

When sufficient material had been collected, one bag was emptied on the ground under the tree and the contents spread uniformly over an area of about nine square feet. To prevent blowing a piece of 2-inch mesh poultry netting was laid over the leaves and staked at the corners. The other bag was taken to the laboratory and the contents allowed to air dry.

After seven to eight weeks the samples under the trees which had been exposed to the weather, were collected and dried. Both the unweathered and the weathered samples were then subjected to chemical analysis.

The trees selected for this study (one tree of each species and the periods of weathering were as follows:

Shade trees surrounded by lawn on Station grounds, New Haven: Shagbark hickory (*Carya ovata*) October 18-December 6 (7 weeks); White oak (*Quercus alba*) October 27-December 22 (8 weeks).

Forest trees in one block of the Eli Whitney Forest, Hamden: Beech (*Fagus grandifolia*) October 22-December 10 (7 weeks); Sugar maple and red maple[1] (*Acer saccharum* and *A. rubrum*) October 25-December 13 (7 weeks).

[1] The maple leaves were nearly all picked from the ground. Equal amounts of each species were taken.

## Results

The data presented in Table 1 show that weathering increased the relative ash content somewhat in all species except the beech. It caused a slight relative increase in nitrogen, but it had practically no effort upon calcium. The potassium content, however, was decreased by about 75 per cent; and phosphorus in variable amounts ranging from 12 to 52 per cent. While the loss of potassium was to be expected, the relatively large loss in phosphorus was surprising. The results are, however, in agreement with those of Schröder.

Unfortunately no data were taken on the loss in dry matter. Perusal of the literature reveals only experiments carried over longer period of time and in an artificial environment. Ramann (3) cites two experiments, one in which 500 gms. of oak leaves in a rain gage decreased to only 225 gms. after 1 year, and to 135 gms. in two years, the losses being 55 per cent and 18 per cent respectively. The second experiment had to do with 200 gm. of beech leaves which, after 6 months weighed 124.7 gms.; 12 months, 75.5 gms.; and 18 months, 47.6 gms. or 37.6 per cent, 24.6 per cent and 13.9 per cent respectively. Falconer, Wright and Beall (2) determined in situ the loss in weight of the combined F and H layers of white, red and jack pines during the period from June to September. The losses they obtained varied from 6.5 to 15 per cent. These results, while interesting, are not applicable to the immediate problem.

Later it is hoped to repeat the experiment on a somewhat larger scale and it will include data on the loss in dry matter. These studies were not of sufficient scope to permit any broad generalizations relative to the comparative losses in different species. The data obtained clearly indicate, however, that the composition of hardwood leaves, particularly the phosphorus and potassium content, changes rapidly after they have fallen to the ground. If any comparisons of species or of sites is to be made on the basis of fresh leaf litter, the samples should be collected direct from the tree or immediately after the leaves have fallen.

The losses noted above are brought about primarily through the leaching effect of rains. Biotic decomposition as such had hardly started at the time of collection. Presumably the leached substances are not immediately lost to the soil but rather absorbed by the underlying humus and mineral soil. The writer has recently installed some lysimeters which, it is hoped, will provide means for determining accurately just what and how

Table 1

Effect of weathering upon the composition of forest leaves calculated to water free basis

| Description | Ash per cent | Ca per cent | Ca Loss per cent | K per cent | K Loss per cent | P per cent | P Loss per cent | Total N per cent |
|---|---|---|---|---|---|---|---|---|
| *Station grounds* | | | | | | | | |
| Hickory, not weathered | 9.36 | 2.03 | .990 | | | .157 | | 1.106 |
| Hickory, weathered | 10.63 | 2.02 | .244 | 75.4 | | .139 | 11.6 | 1.160 |
| White oak, not weathered | 5.71 | 1.36 | .511 | | | .125 | | 0.674 |
| White oak, weathered | 6.02 | 1.40 | .162 | 68.2 | | .072 | 42.4 | 0.715 |
| *Eli Whitney Forest* | | | | | | | | |
| Beech, not weathered | 5.49 | 0.87 | .765 | | | .162 | | 0.706 |
| Beech, weathered | 4.90 | 0.88 | .153 | 80.0 | | .078 | 51.8 | 0.776 |
| Maple, not weathered | 5.57 | 1.12 | .523 | | | .098 | | 0.416 |
| Maple, weathered | 6.14 | 1.17 | .128 | 75.5 | | .054 | 44.6 | 0.541 |

much materials are leached from forest litter, and to what extent these leached substances are absorbed by the soil.

## References

1. Ebermayer, E. 1876. Die Lehre der Waldstreu. Julius Springer, Berlin.
2. Falconer, Joseph G., Wright, J. W., and Beall, H. W. 1933. The decomposition of certain types of forest litter under field conditions. Amer. Jour. Bot. 20:196-203.
3. Ramann, E. 1890. Die Waldstreu. Julius Springer, Berlin.